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LIQUID CRYSTALS AND THEIR PROPERTIES

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ABSTRACT

Liquid crystals are unique materials that possess properties of both liquids and solids, exhibiting remarkable behavior under various conditions. They are characterized by their ability to flow like liquids while maintaining an ordered structure similar to that of crystalline solids. This duality gives rise to a range of fascinating optical and electro-optical properties, making liquid crystals essential in various applications, particularly in display technologies such as liquid crystal displays.

Keywords: Liquid crystals, Thermotropic, Lyotropic, Nematic Phase, Smectic Phase, Cholesteric Phase, Birefringence, Electro-optic Effects, Molecular Alignment, Polarized Light, Display Technologies, Liquid Crystal Displays (LCDs), Self-assembly, Response Time, Optical Properties.

INTRODUCTION

Liquid crystals are materials that have properties that lie between those of a liquid and a solid. They are usually composed of long chain molecules and have mutually ordered structures, but they also have mobility properties that allow them to behave as liquids.

Main properties of liquid crystals:

1. Anisotropy: Liquid crystals have different physical properties in different directions. This means that they can have electrical or optical properties in one direction, but different in another direction.

2. Refraction: Liquid crystals have unique optical properties. They have the ability to control the reception and distribution of light.

3. Thermal properties: Liquid crystals are sensitive to temperature changes and this can affect their properties.

4. Electrical properties: Some liquid crystals can change direction under the influence of an electric field, which allows them to be used in screens and other electronic devices.

5. Mechanical properties: Liquid crystals can respond differently to their mechanical stress, which expands the scope of their use.

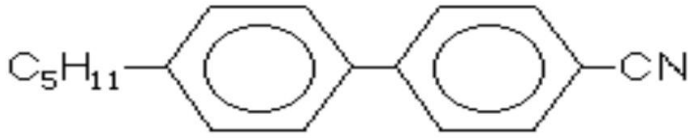
Application:Liquid crystals are used in many technological fields, including:

- **Screens:** LCD (Liquid Crystal Display) technology is widely used.
- **Optical devices:** Optical filtering and modulation using liquid crystals.

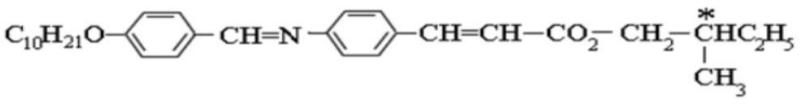
• **Sensors:** When measuring temperature, pressure and other physical parameters.

The study of liquid crystals and a deeper understanding of their properties are important in the development of science and technology. Molecules with a liquid crystalline phase can form different phases depending on the affinity of a particular substance or the form in which the liquid crystalline phase can be divided into liquid crystalline (lyotrope) liquid crystalline (lyotrope), as mentioned earlier. the crystalline phase (thermotropic crystal) contains a certain fraction of the liquid crystalline phase and a certain solvent (lyotropic) C liquid crystal in a certain temperature region. Most of the liquid crystals used in screens are thermotropic liquid crystals, and lyotropic liquid crystals are mainly found in biofilms. Thermal liquid crystals can be divided into nematic (hematic), cholesteric (cholesteric) and near-crystal (smectic) according to their position (positional order) and orientational order (orientational order).

When the center of mass of nematic liquid crystal molecules moves like a liquid, the direction of the long axis of the molecule (long molecular axis) has the same thermal deflection, but it is oriented in a specific direction. The unit shown in this direction is called a vector (leader). Almost all macroscopic physical constants of nematic liquid crystals are single-axis (one-sided) depending on the rotational symmetry of the probe. In addition, the control is symmetrical before and after (starting with downward symmetry), so even though the molecules in it have polarity (polar), nematic liquid crystals do not have polarity. Although its structure is the simplest of the three types of liquid crystals, most of the liquid crystals used in monitors are nematic liquid crystals. It is mainly.



5CB *p-n* pentyl-*p'*-cyanobiphenyl (PCB)



Cholesteric liquid crystals are similar to nematic liquid crystals, but they have a helix structure that rotates along a different vertical axis. In a plane perpendicular to the spiral axis, there is no difference from a nematic liquid crystal. The constituent molecules of the cholesterol liquid crystal phase have a chiral chiral center (chiral) without absolute symmetry, and molecules with king radicals can also be shown in nematic liquid crystals. Therefore, cholesterol liquid crystals are also called chiral nematic. In addition, the direction of rotation

of the spiral axis is determined according to the specificity of the chiral molecules. Therefore, cholesterol liquid crystals are arranged in a regular order, extending along the helix axis. The 1-period length of the helix structure of the cholesterol liquid crystal is called a degree (area), as is the nematic liquid crystal head symmetry, so the actual period is only half a degree. It is usually represented by CLC or ChLC. N* is also used to represent cholesterol liquid crystals. Asterisk represents chiral.

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